Information System for Logistics – Modern Tool for Logisticians

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SUMMARY
The article in its first part characterises main features, capabilities and architecture of the Information System for Logistics (ISL). The second part describes the way and main principles used for building the ISL.
The authors used in the article their experience acquired during their work in the joint development team of the ISL built for the Ministry of Defence and the Army of the Czech Republic.

1. HISTORY AND PRESENT

The Army of the Czech Republic (ACR) has more than twenty-five years long experience in building and using information systems for logistics. Information systems were built to support various areas of logistics. The materiel management was individual for each from about 30 groups of materiel and as well information systems were built separately mostly using mainframe computers. This way of non-uniform materiel record keeping had many disadvantages and led to ineffective materiel economy.

The ACR made a courageous decision to start building a new integrated Information System for Logistics (ISL) in 1994. The aim was to build up a system that will assure compatibility with NATO in logistics benefiting from modern logistic approaches of NATO (e.g. the NATO Codification System) and will increase efficiency in logistic processes saving human and materiel resources. Decision makers of the Ministry of Defence (MoD) and the ACR defined the main objectives of the new ISL:

- To provide a tool for economical control in peace, threat period and in wartime
- To provide a uniform support for all services in the ACR with unified management of all materiel items
- To assure a clear visibility on units' performance
- To allow maximal control over expenditures: man-hours and funds
- To enhance flexibility and reliability
- To achieve interoperability with external systems (NATO, Parliament, other military information systems)

The new ISL should use up-to-date ways of developing information systems and modern means of information technologies.

Since that time the ACR overcame a long way and now a crucial part of the ISL is finished and after completion of the test run and security certification it will be put into full operation.

Thanks to the decision made a long time before joining NATO, the ACR has now the functional, unified, integrated Information System for Logistics – one of basic prerequisites for logistic interoperability within NATO.

2. ISL CAPABILITIES

The Information System for Logistics (ISL) provides support for military logistics in all important areas for both **consumer logistics** and **production logistics**. It ensures uniform support for all services of the armed forces in all over the territory of the country.

2.1. ISL Position and Connections

The diagram (Fig. 1) shows schematically the ISL position and interfaces to other organisations and information systems. There are shown existing connections and potential interfaces prepared for a time, when other information systems will be put into operation.

- **Financial Information System**

Connection to the Financial Information System (FIS) allows using the uniform materiel identification according to the NATO Codification System, which is determinant for all armed forces and is assured by the ISL module MC CATALOGUE. Further it is used for sending accounting data about completed materiel transactions from the ISL to the FIS and an interchange of information related to making and consuming a budget.

- **NATO Maintenance and Supply Agency (NAMSA)**

The connection to NAMSA is very important. It is used for electronic data interchange of materiel codification

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data (transactions) between countries using the NATO Codification System.

♦ **Staff Information System**

It allows a flow of information important for operations planning and controlling.

♦ **Personal Information System**

Interface to the Personal Information System allows interconnection important for an area of preparation and employment of logistics operatives.

♦ **State Information System**

The State Information System defines standards for a uniform information interchange between governmental departments.

♦ **Parliament**

There is assured a possibility to provide Parliament (e.g. the Defence and Security Committee) with reports about a status of crucial weapon systems.

♦ **Logistic Functional Area Sub-System (LOGFASS)**

This interface will allow exchanging the logistics related data of formations assigned to NATO plans by nations.

♦ **Stockholding and Asset Requirements Exchange (SHARE)**

The electronic data interchange with SHARE will allow mutual informing about materiel asset availability and requirements for future joint procurement actions and mutual support.

2.2. ISL Functional Structure

The diagram (Fig. 2) shows the functional structure of the ISL. The diagram depicts the basic functions only, which support mainly materiel, supply and maintenance functions of logistics. The ISL is planned to be enlarged in the second phase to support also other logistic functions, e.g. service, movement and transportation, engineering, etc. Basic characteristics of ISL sub-systems will be described in the following text.

♦ **MC Catalogue**

The *Materiel Codification Catalogue* (*MC Catalogue*) is a basic module of the ISL. It is a tool for materiel codification according to the rules of the *NATO Codification System* (*NCS*) and for logistics categorisation. It allows electronic data interchange with other NATO and non-NATO countries via the NATO Mail Box System (NMBS). The *MC Catalogue* is the heart of the ISL and serves to all other modules and sub-systems as a source of data about materiel. The *MC Catalogue* could be operated as a standing alone system or as a module of the ISL.

The main objectives of the *MC Catalogue*:

- To create a uniform catalogue of materiel for all services of the armed forces
- To provide support for codification of materiel according to the rules of the NCS

♦ **Logistic Requirements**

The *Logistic Requirements* provide tools for work with organisational structures of the armed forces (commanding, logistic, financial) derived from the strategic doctrine and logistic methods of the armed forces. It contains the database of all organisational parts of the armed forces (formations and units) including their links and sub-ordinations.

By means of this module, materiel norms used in the armed forces are also maintained.

Materiel norms define entitlements and specific needs of the organisational parts and their specific needs for various activities. The *Logistic Requirements* also ensure connections between the general materiel norms and standards and specific parts and on that basis it makes it possible to calculate the entitlement of each part with respect to specific materiel items.

♦ **Materiel Record Keeping**

The *Materiel Record Keeping* (*MRK*) is the second basic module of the ISL. It is a tool for the management of central materiel record keeping and creates a basis for a uniform supply system. It follows movements and shipments and the stock level of materiel enrolled in the *MC Catalogue*. It enables transmission of data concerning materiel transactions to an accounting information system (FIS).

The main objectives of the *Materiel Record Keeping*:

- To create a basis for a uniform supply system
- Central materiel record keeping management
- Transmission of data concerning materiel movements and shipments to accounting

♦ **Supply Management Sub-system**

The *Supply Management Sub-system* (*SMS*) covers the **supply function of logistics** that is armed forces materiel assurance. The objective of this area is, within the determined financial and materiel limits, to create optimal materiel conditions for the fulfilment of the armed forces' tasks. The *SMS* is composed of two partial sub-systems: the *Inventory Management* and the *Distribution Management*.

• **Inventory Management Sub-system**

It supports in particular the planning and procurement of materiel. The *Inventory Management Sub-system* is composed of the following modules (according to the DoD terminology called Computer Software Configuration Items – CSCI):

◊ ***Provisioning*** – One of the most important activities of military logistics is to provide the armies with materiel and equipment. There is an immense amount of labour associated with assurance of the operability of the equipment with spare parts and in-time supply of ammunition for the individual organisational parts, while minimising the warehouse inventories which freeze considerable financial and human resources. Therefore, objective needs must be identified. This is done by means of analysing the present situation by:

- Comparing the current inventory level (*Materiel Record Keeping*) with the norms for the individual organisational parts (*Logistic Requirements*)
- Including expected consumption derived from experience of past consumption (the *Materiel Record Keeping*) with known past and future activity of the armed forces (the *Equipment Maintenance Sub-system*)

- Taking into account the expected time of delivery
- Taking into account the time of usability of materiel (the *Materiel Record Keeping* – expiration), percentage of reparability of the damaged materiel (the *MC Catalogue*), etc.

The result consists of an objective evaluation of the future needs of the armed forces. This result is subsequently modified according to the budget resources assigned (taken from the Planning, Programming and Budgeting System – PPBS). After such a modification it is submitted for implementation (the *Acquisition and Procurement Directions*).

Information concerning the surplus or useless materiel identifies inputs of the *Disposal*, where it is further processed.

The main objectives of the *Provisioning*:

- Forecasting the needs of the armed forces and comparing them with resources; offering objective data for decision-making by an item manager
- Providing data needed for the generation of an acquisition and procurement direction
- Signalling the existence of surpluses and suggesting a method of processing

◊ ***Acquisition and Procurement Directions*** – The purpose of this module is to support decision-making concerning which materiel will be procured for the armed forces and in what amounts (purchase, manufacture). The main input consists of data created by the *Provisioning*.

The directions created in the *Provisioning* with respect to the assurance of the materiel needs of the armed forces, are connected together to form requirements that are approved within the scope of the hierarchical structure of the armed forces and hand over to the acquisition centre. Appropriate contracts are signed with suppliers. These contracts are followed in the *Acquisition and Procurement Directions*.

The information concerning the individual expected supplies is distributed to the individual local servers (in warehouses equipped with the *Receiving*) that on this basis implement receipt of materiel from suppliers.

After physical receipt of the supply, data concerning the gradual fulfilment of the contracted supplies are sent from the *Receiving* to the *Acquisition and Procurement Directions* at the central server.

The main objectives of the *Acquisition and Procurement Directions*:

- Creating, approving and checking the acquisition and procurement directions
- Record keeping of the contracts entered into and monitoring of their execution
- Providing the data from the contracts necessary for the receipt of materiel

◊ ***Distribution Directions*** – Their purpose is to create directions for the complementing of the inventory level according to the amount standard applicable to the individual organisational parts of the armed forces.

Distribution directions are created based on requirements for materiel from the organisational parts of the armed forces (entered at local servers by means of the *Distribution Directions*), or based on a parametrisable automated calculation done by comparing the current inventory level (the *Materiel Record Keeping*) with standards for the individual organisational parts (the *Logistic Requirements*).

The distribution direction is sent to the local server of the issuing warehouse (central warehouse or armed forces formation) to be implemented.

The main objectives of the *Distribution Directions*:

- Enabling control of the distribution process in the armed forces
- Creating distribution directions automatically and manually
- Managing materiel requirements

• **Distribution Management Sub-system**

The *Distribution Management Sub-system* (*DMS*) supports in particular supply and materiel management (supplies to armies according to the defined standards, creation of the necessary inventory, supplies of consumer materiel, definition of conditions for materiel storage, materiel handling, sale and disposal of surplus and useless materiel). The *DMS* is composed of the following modules:

◊ ***Movements and Shipments*** – the basic tool for the implementation of physical movements and shipments within the armed forces.

◊ ***Receiving*** – the basic tool for the implementation the physical movements and shipments from civil organisations to the armed forces and from the armed forces to civil organisations.

◊ ***Storage*** – supports storage of materiel at the place of its location, stocktaking, maintenance of materiel in long-term storage, etc.

◊ ***Issuing*** – supports the activities connected with the collecting of items from locations in warehouses on the basis of directions from other modules.

◊ ***Disposal*** – supports the process of retrieval of items to be disposed of, the approval of the individual recommendations for materiel to be disposed of, and the monitoring of the process of the implementation of physical disposal or sale of the materiel.

♦ **Logistic Management Sub-system**

The *Logistic Management Sub-system* (*LMS*) serves in particular top-level logisticians. It is composed of the following modules:

◊ ***Control (Performance Indicators)*** – is designed for the top level of logistics. It serves to evaluate the logistic performance and effectiveness of logistic entities (formations, warehouses, bases) and processes (supply, maintenance, storage, etc.). It defines the objectives, intentions, measurable norms and performance indicators. Based on these, it compares the actual performance with the relevant norms and presents the result to the user.

The *Control (Performance Indicators)* contains tools that make it possible to combine the performance indicators into groups for evaluation of comprehensive situations. It also makes it possible to perform several types of result analyses in order to support decision-making.

◊ ***Operation Logistic Support Planning*** – provides support for the logistic assurance of operations of the armed forces. It provides a comprehensible overview of the existing situation during the entire operation and supports continuous planning of the logistic support. Information concerning the achieved status of logistic assurance and the existing requirements are transmitted between the individual commanding levels of the armed forces by means of logistic reports.
Logistic support planning takes place with a close direct link to the command and control of the operation.

♦ **Equipment Maintenance Sub-system**

The *Equipment Maintenance Sub-system* (*EMS*) is designed to support the activities related to the planning and executing of the equipment maintenance. A substantial part of the *EMS* is formed by the monitoring of the operation of equipment. The *EMS* is composed of the following modules:

◊ ***Standards, Norms and Procedures*** – create a database containing a source of information necessary for the majority of processes of the two remaining EMS modules. The database contains in particular information concerning specifications of maintenance and constant tables of various codes with corresponding textual descriptions. The module also makes it possible to monitor the operation, maintenance and composition of specific items of equipment. (Specific items of equipment are explicitly defined in the *Standards, Norms and Procedures* by means of a catalogue number and a record keeping number.)

◊ ***Maintenance Planning*** – supports the user in creating long-term and detailed plans of maintenance, in evaluating the use of maintenance resources with respect to their capacities, and in developing working plans for repair facilities.
The module also makes it possible to monitor the actually implemented operation of the specific items of equipment and compare it with the annual plan of operation.

◊ ***Maintenance Execution and Control*** – supports monitoring of maintenance (both scheduled and unscheduled) executed both in the armed forces' repair facilities and in repair facilities outside the armed forces. By means of a link to maintenance, it is possible to keep records concerning the resources consumed (standard hours, spare parts, services purchased). Information so obtained is used to evaluate the norms of resource consumption for individual types of maintenance and for financial definition of costs of the maintenance executed.
The module also makes it possible to record information concerning defects. Such information is then used in the calculation of performance indicators by means of which it is possible to evaluate the reliability of the equipment.

2.3. Life Cycle of Item of Supply

The capabilities of the ISL support an item of supply during the whole life cycle of materiel. The basic scheme of the item life cycle supported by the ISL functions is depicted on the diagram (Fig. 3).

- The *Provisioning* compares the current inventory level (from the *Materiel Record Keeping*) with the norms for units, formations, etc. (from the *Logistic Requirements*) and as the result calculates the future needs of the armed forces. This result is corrected according to a budget taken for example from the PPBS (Planning, Programming and Budgeting System). The corrected result is submitted for implementation to the *Acquisition and Procurement Directions* and information concerning the surplus or useless materiel enters the *Disposal*.
- The *Acquisition and Procurement Directions* sum the directions created in the *Provisioning* according to possible suppliers and create requirements for the acquisition centre. The data about a concluded contract enter the *Acquisition and Procurement Directions* where they are followed. The information about expected supplies is then distributed to the *Receiving* on the individual servers.
- The *Receiving* supports the process of receiving of materiel from civil organisations to the armed forces. It compares incoming materiel with contracts and creates reports about fulfilment of the contracts for the *Acquisition and Procurement Directions*. The *Receiving* also generates data, so called transaction documents, which are sent using modules of the *Materiel Record Keeping* to the Financial Information System for accounting purposes.
- The *Storage* supports activities performed in warehouses like storing items in a proper location, stocktaking, etc.
- The *Disposal* processes materiel to be disposed of.
- The *Distribution Directions* create directions for the complementing of the inventory level according to the amount standard defined for each organisational unit of the armed forces. These directions are the input for the *Issuing*.
- The *Issuing* creates plans for issuing according to the directions obtained from the *Distribution Directions*. It supports a process of collecting materiel from a warehouse and prepares data about the collected materiel for the *Movements and Shipments*.
- The *Movements and Shipments* support the process of packing, completion and shipping shipments. It monitors physical movements of materiel amongst the organisational units of the armed forces and

provides the *Materiel Record Keeping* with data – transaction documents, for accounting in the Financial Information System.
- Issued and distributed materiel is used, maintained and consumed in the armed forces and information about the actual inventory level is used by the *Provisioning* for new calculation of armed forces' needs.

3. ISL ARCHITECTURE

The ISL manages logistic activities, items, stocks and transactions. The stocks can be found in warehouses, in units, in movement between warehouses and units, and in the process of receiving (stock comes into the armed forces) or process of consumption and disposal (stock gets out of the armed forces). Logistic activities (like maintenance, provisioning, etc.) are also done at different levels of the armed forces.

The main concept is to allow independent work in different sites, but managing logistics in a central armed forces system. This concept lets each site (warehouse, unit or troop recording department) manage stocks and record transactions without regarding to the availability of communications to the central site. On the other hand, the central files will be updated (on-line or by batch) for every transaction, thus allowing to maintain a centralised logistics management, and capability for the provisioning and acquisition of stocks.

To meet the above mentioned concept the ISL is designed as a centralised distributed system. A network of servers is deployed over all the country including extraterritorial locations. The servers are interconnected by WAN, telephone lines or, when electronic connection is not available, data are distributed by a suitable memory medium like CD ROM. Databases in all servers are updated by the sophisticated utility "Data Distribution" so that information in all locations is always consistent and up-to-date. The scheme of the *Supply Management Sub-system* architecture is depicted on Fig. 4.

4. TECHNICAL BACKGROUND

The state-of-the-art information technology is used for ISL development. The application is built using the multi-tier client / server architecture with a graphic user interface. The whole process of software development is supported by so called "technological line" composed of a set of software tools like CASE (Computer Aided Software Engineering), source code generators, tools for automated software testing and of methodologies and working procedures. Developers can focus their effort to creative work and routine activities are carried out by supporting tools.

4.1. Technological Line

Considering other industrial branches automation in software development is still little used. It is obviously given by it that the major part of software development activities has creative nature and it is difficult to automate creative work. Nevertheless, even in software development there is number of tasks that can be supported by various software tools. Thus the development team can focus its effort mainly to creative activities and to reach high effectiveness.

For large projects other reason for using suitable tools for software development arises. A large team numbering several tens of members cannot be composed of only top analysts and programmers and badly there will be number of only average members. Therefore it is preferable for a project manager to establish a narrower team of top creative employees whose task is to develop and establish from selected components such a support for the whole team that even average analysts and programmers could work effectively and generate high-quality software.

It is appropriate to use commercial-off-the-shelf (COTS) software for establishing the development environment. However COTS software usually does not meet fully all requirements of project methodology and it is necessary to modify it or to develop additions. Therefore one of the most important features for software selection is their openness.

The selected COTS software, its additions and modification must be then completed by working procedures corresponding to chosen methodology covering all stages of a project life cycle. By creating the working procedures defining what must be done in what time, what are inputs and outputs, what tools will be used and what professions will participate a software company gets closer to production in other industrial branches. A software company acquires thus a technological line for production of software and creates prerequisites successful solution of even large software projects.

To create a high-quality technological line is not a simple task. It is a gradual process based on collecting experiences and ongoing "tuning" of all components of a technological line to optimal configuration.

A high-quality technological line should comprise of tools supporting the whole project life cycle. The itemization of key tools used in particular stages of the project life cycle follows:

- **Analysis**
  - Tools supporting record-keeping of software requirements (advantage if it is a part of a CASE tool)
  - CASE tool
- **Design**
  - CASE tool
- **Programming**
  - CASE tool
  - Program languages, the main program language should have a bridge from a CASE tool supporting automated source code generation
- **Testing**
  - Tools for automated testing software supporting also manual testing
  - Tools supporting the record-keeping of software requirements (allowing monitoring verification of specified requirements)
  - Tool supporting software configuration management

- **Maintenance**
- For software modification same tools as for development are used
- Tool for the record-keeping of problem reports (advantage if it is a part of a tool for automated testing)
- Tool supporting software configuration management

5. CONCLUSION

Success of large software projects is given on one hand by a clear vision of a customer as a future user of an information system and on the other hand by a capability of a development team to realise customer's vision and to develop high-quality software meeting users' needs.
It could be stated that in the case of the Information System for Logistic both prerequisites where fulfilled and the success has been reached. It is necessary to admit that the way was not always easy and both the customer and the developer had to learn and look for an optimal solution of difficult situations.